REMARKS

Claims 1, 2, 4-27, and 30-46 are now in the case. Claims 3, 28, and 29 have been canceled, and claims 45 and 46 have been added.

The several objections to the form of the claims have been overcome. The improper multiple dependencies have been corrected. The use of "such as" in claim 39 has been dropped in favor of a Markush group. Claim 10 has been divided into two claims--claims 10 and 45, the latter to provide a proper antecedent. Claim 12 has been amended and divided into two claims--claims 12 and 46, both claims being written in a definite form. As to the meaning of the term "intermediate" as used herein, its meaning is "between."

Apart from the above, the claims have been amended to delete internal numerals; several claims (4, 19, 23, 26, 43) have been amended to provide a proper antecedent; several claims (11, 12) have adopted the term "spacer means" for consistency; several claims (8, 17, 38, 40) have eliminated indefinite or parenthetical clauses; and claims 34, 35, 40, and 42 have been amended to reference better the test membrane that is being monitored.

Claims 41, 42, and 44 stand rejected under 35 U.S.C. §§ 112, 101. This rejection is respectfully traversed. The intention of claims 41, 42, and 44 is to obtain protection for the use of the monitoring unit in evaluating operating parameters, as recited in these claims, of a reverse osmosis purification system. The evaluation of these parameters is achieved by locating the unit in-line with a conventional reverse osmosis water purification system and by simulating the conventional operating parameters of the water purification system in the monitoring unit. Evaluation is then conducted by visual and physical inspection. In view of this explanation, the

amendments to these three claims, and the structural recitations, it is submitted the rejection under Sections 112 and 101 has become moot.

Claims 1, 2, 6, 7, 10-12, 30, 31, 34, 35, 37, 39, and 40-44 stand rejected under 35 U.S.C. § 103(a) as unpatentable over the U.S. Patent to Bond et al. ("Bond") No. 6,161,435. This rejection is respectfully traversed. New claims 45 and 46 are included in this traversal.

Bond teaches a method and apparatus for monitoring the state of fouling of a membrane within a membrane module, on-line and in real time, in a system for treating water or other liquids, the monitoring being achieved by the use of ultrasonic or acoustic time-domain reflectometry . As taught, Bond provides ultrasonic transducers on a membrane module forming part of a water purification system and compares an echo signal from the membrane with a reference echo signal and thereafter determines the state of fouling as a result of the comparison. Applicants respectfully submit that from a reading of Bond it would not be obvious to provide for a separate monitoring unit which is located in-line with a water purification system including a membrane module, wherein the monitoring unit contains its own membrane and wherein the operating conditions of the water purification system are simulated in the monitoring unit. Furthermore, it would not be obvious from a reading of Bond to provide a monitoring unit wherein both visual and physical inspection of the test membrane is possible, and in respect of the latter, wherein the physical inspection can be carried out without having to take the water purification system off-line.

Bond also does not teach a separate monitoring unit having the inspection window claimed herein. Referring to col. 1, lines 59 to 67, Bond discusses the use of an

optical probe to detect fouling. Use of an optical probe requires that an optical window be formed in the wall of the housing that internally holds the membrane in the water purification system itself. It would not have been obvious from a reading of Bond to provide a separate monitoring unit, let alone a separate monitoring unit having an optical window to permit visual inspection of the membrane. Indeed, Bond appears to teach away from the use of visual inspection because the patent states that optical probes obtain information concerning fouling with regard to the outermost portion of the membrane and that providing for optical probes is not practical in commercial, high-pressure membrane modules. Also, see col. 3, lines 41 to 44 where Bond states that its invention does not require any type of window to be cut in the housing to detect membrane fouling. Applicants' method and apparatus not only require visual inspection, but also allow for physical inspection of the membrane by destructive analysis without taking the main apparatus and system off-line, thereby overcoming the disadvantage alleged by Bond of only being able to determine fouling on the outermost portions of the membrane.

Those skilled in the art will appreciate that monitoring of a membrane system as disclosed in Bond is very accurate, but has the disadvantage of being relatively complicated, when compared with the present invention, and requires incorporation into the main in-line system. Applicants' invention overcomes these disadvantages by providing an in-line monitoring unit that can be placed in-line and taken off-line at any time while the water purification system including the membrane module is running, thus significantly decreasing the down-time of the system. Furthermore, applicants'

invention provides an easily operable and fairly inexpensive method of monitoring fouling within a membrane system on-line, in real-time, and non-invasively.

Applicants respectfully submit that a person skilled in the art looking to find an inexpensive and easy-to-operate apparatus and method to monitor membrane system fouling on-line, in real-time, and non-invasively would not even have considered Bond which discloses a complicated and fairly expensive solution to the problem. It is therefore submitted that applicants' inventions, as set forth in claims 1, 2, 6, 7, 10-12, 30, 31, 34, 35, 37, 39, and 40-44, are not obvious based on the disclosure in Bond.

With regard to dependent claims 10 to 12, 30, 45, and 46, the figures in Bond do not appear to use spacers to provide a flow space between the fluid permeable support member and the membrane, which spacers are used to stimulate real fluid-flow dynamics of, for example, various reverse osmosis (RO) membranes. Bond does not teach a separate monitoring unit wherein spacers can be added or removed in order to stimulate such fluid dynamics, and these claims further distinguish over Bond.

With regard to dependent claim 31, and taking into account the fact that Bond does not teach the use of a separate monitoring unit, it would not have been obvious to a person skilled in the art to read Bond as suggesting that not only should a separate monitoring unit be provided for, but that the conditions of the membrane module in a system be simulated in the monitoring unit. Applicants respectfully submit that claim 31, as well as claim 35 and independent claims 41 to 44, are further inventive over Bond.

With regard to dependent claim 40, Bond does not teach the measuring of flux, i.e., the passage of pure water through the membrane in the method of claim 34 where any deviation in flux is attributable to adsorption of impurities onto the membrane.

Dependent claims 18-23, 32, and 33 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Bond further in view of the U.S. Patent to Zeiher et al. ("Zeiher") No. 6,017,459. This rejection is respectfully traversed.

Zeiher discloses in-line apparatus and method for monitoring the fouling of a test membrane in a filtration system. Zeiher discloses apparatus allowing for visual inspection of the membrane by providing a window for observation of film formation on the membrane and to the use of such apparatus in-line with the filtration system (main apparatus) so that one can avoid unscheduled down-time of the filtration system. In Fig. 1 showing the flow direction of concentrate from the filtration system, and col. 5, lines 9-11 and 39-41, the test membrane is used to monitor membrane deposition within a filtration system. The concentrate, however, does not pass through the membrane itself. Instead, the flow of liquid is parallel to the direction of the membranes. Because the liquid is not forced through the membranes themselves, the liquid that is filtered makes contact only with the membrane surface.

Another difference between Zeiher and the applicants' apparatus and method is that the applicants provide in their apparatus both a feed fluid outlet and a fluid outlet for the permeate after water passes through the membrane and the semi-permeable support member. Applicants' membrane is positioned on top of the semi-permeable support member such that when the flow chamber fills with water at a desired pressure, the water will be allowed to pass through the membrane due to reverse osmosis. Water thus not only passes through the membrane itself, but also through the semi-permeable support member into the permeate chamber or outlet and eventually out of the monitoring unit as permeate. By applying a specific flow and pressure in the flow

chamber, a certain amount of water will pass through a specific area of the exposed membrane. By measuring the amount of water or permeate that flows through the membrane, flux can be measured. Because Zeiher does not teach or suggest the use of a porous support member for its membrane, water will not pass through the membrane and on-line flux is not measured. Zeiher also does not teach the use of membrane spacers, which in the applicants' case may be fitted on top of the membrane to simulate flow dynamics of various membranes.

Thus, although Zeiher may show a membrane, valves, conduits, pumps, pressure gages and the like, it fails to correct the shortcoming of Bond as discussed above and further fails to teach or suggest the claimed structure and process of applicants. Indeed, the differences in construction and use of the membrane monitoring apparatus of Zeiher and that of applicants is so significant, as pointed out above that it is submitted there would be no motivation to someone skilled in the art to combine Bond and Zeiher, as the Examiner proposes.

Dependent claims 24 and 26 stand rejected under 35 U.S.C. § 103(a) as unpatentable based on Bond further in view of the U.S. Patent to Pearl et al. ("Pearl") No. 5,599,447. This rejection is also respectfully traversed. Pearl shows the use of a manifold in tangential flow filtration apparatus. Combining Pearl with Bond, even if permitted, would not correct the shortcomings of Bond as discussed above. Moreover, there does not appear to be any motivation for combining these two patents. The mere fact that two references might be combinable does not justify their being combined without some motivation for doing so. Here, as in the rejection based on Bond and Zeiher, there appears to be a piecemeal combination of two patents without motivation

for doing so, absent applicants' own teachings which cannot be used as a basis to combine the two patents.

Reconsideration and allowance of claims 1, 2, 4-27, and 30-46 are earnestly solicited.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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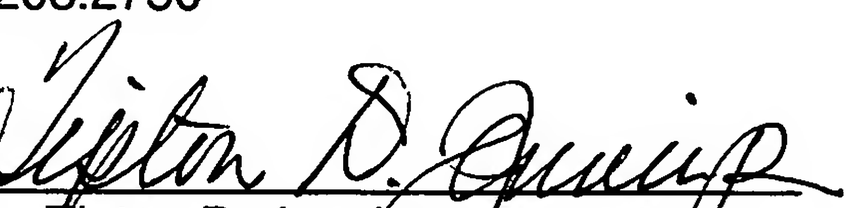
By: 
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